(19)日本国特許庁（ＪＰ）　(12)公開特許公報（A）　(11)特許出願公開番号

特開平5－40209

(43)公開日　平成５年(1993)２月19日

(51)Int.Cl.[5]	識別記号	ＦＩ
G02B 6/26	7132-2K	
H01B 11/00	6969-5G	

審査請求　未請求　請求項の数３　（全４頁）

(21)出願番号　特願平3－221232

(22)出願日　平成３年(1991)８月７日

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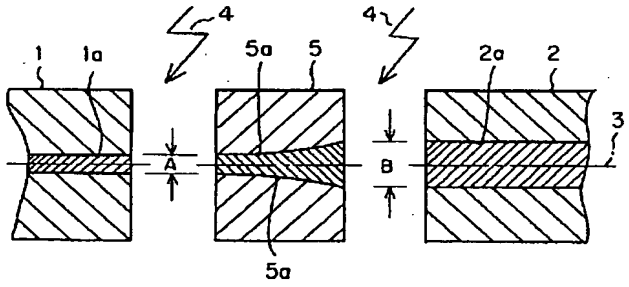
(54)【発明の名称】光結合構造

(57)【要約】

【目的】　接続する光ファイバの軸合せを容易化し、接続損失を少なく光結合可能にする。

【構成】　コア径が異なる一対の光ファイバ１，２を設けるとともに、各端面のコア径が上記各光ファイバ１，２の各コア径に対応し、かつ上記各光ファイバ１，２間に介在されて融着された光ファイバテーパ５を設ける。



1，2：光ファイバ
5：光ファイバテーパ

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【特許請求の範囲】

【請求項１】　光信号を光ファイバに結合する光ファイバ結合構造において、コア径が異なる一対の光ファイバと、各端面のコア径が上記各光ファイバの各コア径に対応し、かつ上記各光ファイバ間に介在されて融着された光ファイバテーパとを備えたことを特徴とする光結合構造。

【請求項２】　光信号を光ファイバに結合する光ファイバ結合構造において、光結合端面の径が異なる一対の光コネクタと、各端面のコア径が上記各光コネクタ間に介在されて接続された長尺の光ファイバテーパとを備えたことを特徴とする光結合構造。

【請求項３】　光信号を光ファイバに結合する光ファイバ結合構造において、発光素子からの光を集光するレンズと、該レンズで集光した光を、コア径が異なる一方の端面に受けて伝達する光ファイバテーパとを備えた光結合構造。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】この発明は、光ファイバどうしや、発光素子および光ファイバ間で光を結合するのに用いる光結合構造に関するものである。

【０００２】

【従来の技術】図７は従来の光結合構造を示す正面図であり、図において、１は光ファイバ、１ａは光ファイバ１のコア、２は光ファイバ、２ａは光ファイバ２のコア、３は各光ファイバ１，２のコア中心軸、４は光ファイバ融着の際のアーク放電である。

【０００３】次に動作について説明する。通常、光ファイバの融着範囲は、光ファイバのコア径が数１０μｍ～数μｍと細いため、軸合わせが必要であり、例えば、コア径が５０μｍのＧＩ型光ファイバでは一般に外径合わせが行われ、またコア径の小さいＳＭ型光ファイバではコアの軸合わせが行われている。さらに、コア径が小さく、しかも径の異なる光ファイバの融着には、より高度な軸合わせが必要となる。図７においては、コア径がＡの光ファイバ１とコア径がＢの光ファイバ２とを、それぞれコア中心軸３を正確に一致させたあと、アーク放電４により融着を行って、一本に結合される。

【０００４】

【発明が解決しようとする課題】従来の光結合構造は以上のように構成されているので、コア径Ａ，Ｂの異なる２本の光ファイバ１，２の接続には非常に高度な軸合わせが必要であり、軸合わせが不十分であると、光ファイバ１，２の各コア１ａ，２ａの偏心による接続損失の増加が避けられないなどの問題点があった。

【０００５】この請求項１の発明は上記のような問題点を解消するためになされたもので、高度な軸合わせの技術や作業を必要とせずに、コア径が相互に小さく、しかもこのコア径が異なる２本の光ファイバを、接続損失なく、かつ容易に結合することができる光結合構造を得ることを目的とする。

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【０００６】また、この請求項２の発明は２本の光コネクタを用いて光ファイバを接続損失なく結合できる光結合構造を得ることを目的とする。

【０００７】さらに、この請求項３の発明はレンズを用いて発光素子と光ファイバを接続損失少なく結合できる光結合構造を得ることを目的とする。

【０００８】

【課題を解決するための手段】この請求項１の発明に係る光結合構造は、コア径が異なる一対の光ファイバと、各端面のコア径が上記各光ファイバの各コア径に対応し、かつ上記各光ファイバ間に介在されて融着された光ファイバテーパとから構成したものである。

【０００９】また、この請求項２の発明に係る光結合は、光結合端面の径が異なる一対の光コネクタと、各端面のコア径が上記各光コネクタ間に介在されて接続された長尺の光ファイバテーパとから構成したものである。

【００１０】さらに、この請求項３の発明に係る光結合構造は、発光素子からの光を集光するレンズと、該レンズで集光した光を、コア径が異なる一方の端面に受けて伝達する光ファイバテーパとから構成したものである。

【００１１】

【作用】この請求項１の発明における光ファイバテーパは、コア径が異なる２つの光ファイバに接続されても、その接続部で各コア径が一致するため、融着結合と相まって、光の接続損失を十分に抑えられるようにする。

【００１２】また、この請求項２の発明における光ファイバテーパは、径の異なる光ファイバにそれぞれ接続されるべき光コネクタに対して、接続損失なく接続可能にする。

【００１３】さらに、この請求項３の発明における光ファイバテーパは、レンズによって集光した発光素子からの光を接続損失なく結合可能にする。

【００１４】

【実施例】

実施例１．以下、この請求項１の発明の一実施例を図について説明する。図１において、１はコア径がＡの光ファイバ、２はコア径がＢの光ファイバ、５はコア５ａを持ち、その一端のコア径がＡで、他端のコア径がＢである光ファイバテーパ、３は各コア中心軸であり、４は融着接続の際のアーク放電である。

【００１５】次に動作について説明する。まず、コア径が異なる各光ファイバ１，２の接続に当たって、これらの間に光ファイバテーパ５を介在し、各光ファイバ１，２と光ファイバテーパ５との各端面を、各コア径ＡおよびＢについて等しいものどうしを対向配置させる。続いて、この対向配置状態のまま、上記各端面を衝き合わせて接合し、この接合部を放電電極間に介在し、アーク放電にて融着することにより１本の繋った光ファイバ体と

する。

【００１６】実施例２．なお、この実施例では光ファイバ１，２の融着接続に用いるファイバテーパ５として、コア５ａのコア径が一端から他端に向かって滑らかにわん曲するものを示したが、図２のように、コア径が一端から他端に向かってまっすぐに拡大または縮小するものや、図３のように一端から他端に向かって、コア径がことなる部分Ｐ，Ｑとこれらを繋ぐまっすぐな部分Ｒとを連続させたものや、図４のように一端から他端に向かって鼓状Ｓに径を異ならせたりしてもよく、上記実施例と同様の効果を奏する。

【００１７】実施例３．図５はこの請求項２の発明の一実施例を示し、図において、５Ａは比較的長尺の光ファイバテーパ、６はこの光ファイバテーパ５Ａのコア径が小さい方に接続された径が小さい光コネクタ、７はコア径が大きい方に接続された径が大きい光コネクタである。一般にコア径の異なる光ファイバでは、コア径が小さい方から大きい方への光伝達は、低接続損失で行えるが、逆にコア径が小さい方から大きい方への光伝達では、接続損失が増大する。

【００１８】そこで、図５では光ファイバテーパ５Ａを上記のように長くし、これらの両端に径の異なる光コネクタ６，７を取り付けた構成としているため、これらの入出射端でコア径の異なる光ファイバを接続した場合に、低接続損失で双方向の光の伝送を行うことができる。

【００１９】実施例４．図６はこの請求項３の発明の一実施例を示す。これは発光素子と光ファイバの結合に光ファイバテーパを用いた例である。すなわち、５Ｂは光ファイバテーパ、８は発光素子、９は光ファイバテーパ５Ｂに光を結合するレンズ、１０は発光素子の発光光、３はコア中心軸である。これによれば、発光素子８の発光光１０はレンズ９で屈折されて、光ファイバテーパ５Ｂの端面、具体的にはコア径の大きい方の端面に入射される。

【００２０】一般に、コア径の小さい光ファイバと、発光素子との結合は非常に困難であり、結合後の光ファイバ端出力は、その結合損失が大であるため、小さくなる。この発明のように、レンズ９および光ファイバテーパ５Ｂを発光素子８と光ファイバとの結合に用いると、発光素子８と光ファイバの結合効率が高まり、結合後の光ファイバ端出力を大きくできる効果がある。

【００２１】

【発明の効果】以上のように、この請求項１の発明によればコア径が異なる一対の光ファイバを設けるとともに、各端面のコア径が上記各光ファイバの各コア径に対応し、かつ上記各光ファイバ間に介在されて融着された光ファイバテーパを設けたので、コア径が小さく、かつコア径の異なる２本の光ファイバの融着を行う際にも、コアの中心軸合わせが容易になり、接続損失の小さい融着接続が行えるものが得られる効果がある。

【００２２】また、この請求項２の発明によれば、光結合端面の径が異なる一対の光コネクタを設けるとともに、各端面のコア径が上記各光結合端面の径に対応し、かつ上記各光コネクタ間に介在されて接続された長尺の光ファイバテーパを設けたので、径が異なる光ファイバ相互の接続を極めて簡単に実施できるものが得られる効果がある。

【００２３】さらに、この請求項３の発明によれば、発光素子からの光を集光するレンズを設けるとともに、該レンズで集光した光を、コア径が異なる一方の端面に受けて伝達する光ファイバテーパを設けたので、発光素子からの光を接続損失なく確実に光ファイバへ伝えることができるものが得られる効果がある。

【図面の簡単な説明】

【図１】この請求項１の発明の一実施例による光結合構造を示す断面図である。

【図２】図１における光ファイバテーパの他の実施例を示す断面図である。

【図３】図１における光ファイバテーパのさらに他の実施例を示す断面図である。

【図４】図１における光ファイバテーパのまたさらに他の実施例を示す断面図である。

【図５】この請求項２の発明の一実施例による光結合構造を示す正面図である。

【図６】この請求項３の発明の一実施例による光結合構造を示す断面図である。

【図７】従来の光結合構造を示す断面図である。

【符号の説明】

１，２　光ファイバ

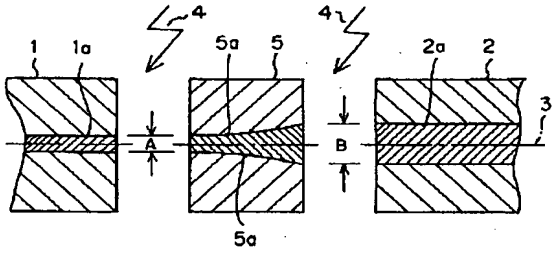
５，５Ａ，５Ｂ　光ファイバテーパ

６，７　光コネクタ

８　発光素子

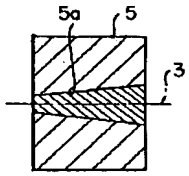
９　レンズ

【図１】

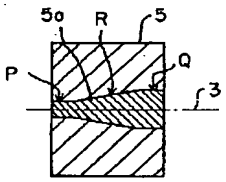


1, 2：光ファイバ
5：光ファイバテーパ

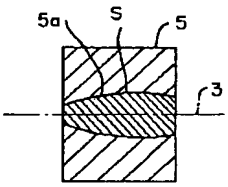
【図２】



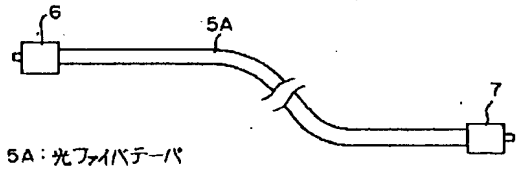
【図３】



【図４】

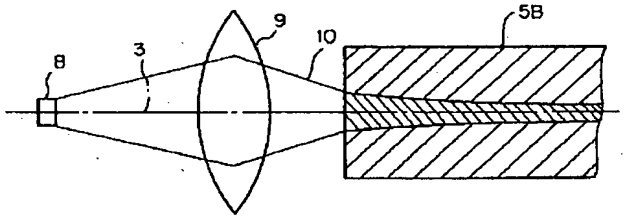


【図５】



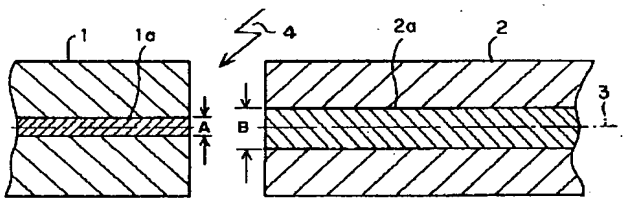
5A：光ファイバテーパ
6, 7：光コネクタ

【図６】



5B：光ファイバテーパ
8：発光素子
9：レンズ

【図７】



PATENT ABSTRACTS OF JAPAN

(11)Publication number : 05-040209
(43)Date of publication of application : 19.02.1993

(51)Int.Cl. G02B 6/26
H01B 11/00

(21)Application number : 03-221232
(22)Date of filing : 07.08.1991

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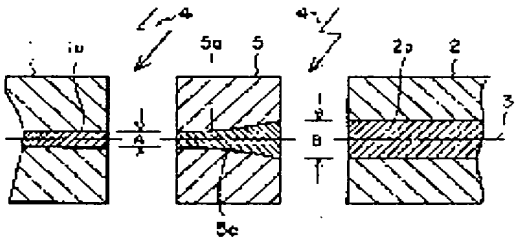
(72)Inventor : UCHIYAMA NORIHIRO

(54) PHOTOCOUPLING STRUCTURE

(57)Abstract:
PURPOSE: To easily align the axes of optical fibers to be connected and to decrease the loss of connection by providing an optical fiber taper interposed and fused between the respective optical fibers while making the core diameters of respective end faces correspondent to the core diameters of the respective optical fibers.
CONSTITUTION: In the case of connecting respective optical fibers 1 and 2 differing core diameters A and B, an optical fiber taper 5 is interposed between these optical fibers, and the respective optical fibers 1 and 2 and the respective end faces of the optical fiber taper 5 are opposed to each other corresponding to the respective core diameters A and B. Next, the respective end faces are abutted and joined while keeping this facing state, this joint part is interposed between discharging electrodes, and one linked optical fiber body is formed by fusing them with arc discharging 4. Thus, since the core diameters of the respective end faces of a pair of optical fibers are made correspondent to the respective core diameters of the respective optical fibers and the optical fiber taper is provided while being interposed and fused between the respective optical fibers so that the respective core diameters can be made incident on the connected part, the connection loss of light can be sufficiently suppressed.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's

decision of rejection]
[Date of extinction of right]

* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] Optical coupling structure characterized by having the optical fiber taper by which welding was carried out by the optical fiber of a pair with which core diameters differ, and the core diameter of each end face being equivalent to each core diameter of each above-mentioned optical fiber in the optical fiber joint structure which combines a lightwave signal with an optical fiber, and intervening between each above-mentioned optical fiber.
[Claim 2] Optical coupling structure characterized by having the optical connecter of a pair with which the paths of an optical coupling end face differ, and the long optical fiber taper to which the core diameter of each end face was connected by intervening between each above-mentioned optical connecter in the optical fiber joint structure which combines a lightwave signal with an optical fiber.
[Claim 3] Optical coupling structure equipped with the optical fiber taper with which while differ, and a core diameter receives and transmits the light which condensed with the lens which condenses the light from a light emitting device, and this lens in the optical fiber joint structure which combines a lightwave signal with an optical fiber to an end face.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the optical coupling structure of using for combining light between optical fibers, and a light emitting device and an optical fiber.
[0002]
[Description of the Prior Art] Drawing 7 is the front view showing the conventional optical coupling structure, and, for the core of an optical fiber 1, and 2, an optical fiber and 2a of the core of an optical fiber 2 and 3 are [1 / an optical fiber and 1a / the core medial axis of each optical fibers 1 and 2 and 4] the arc discharge in the case of optical fiber welding in drawing.
[0003] Next, actuation is explained. Usually, since the welding range of an optical fiber has the core diameter of an optical fiber as thin as several 10 micrometers - several micrometers, axial doubling is required for it, for example, generally in GI mold optical fiber whose core diameter is 50 micrometers, outer-diameter doubling is performed, and axial doubling of a core is performed in SM optical fiber with a small core diameter. Furthermore, a core diameter is small and axial more advanced doubling is needed for the welding of the optical fiber with which paths moreover differ. In drawing 7 , after a core diameter makes the core medial axis 3 of the core diameter [the optical fiber 1 and core diameter] of A the optical fiber 2 of B correspond correctly, respectively, it performs welding by arc discharge 4, and is combined with one.
[0004]
[Problem(s) to be Solved by the Invention] Since the conventional optical coupling structure was constituted as mentioned above, there were troubles -- axial, very advanced doubling is required for connection of two optical fibers 1 and 2 with which core diameters A and B differ, and the increment in connection loss according that axial doubling is inadequate to the eccentricity of each cores 1a and 2a of optical fibers 1 and 2 is not avoided.
[0005] Invention of this claim 1 was not made in order to cancel the above troubles, and without needing the technique of axial advanced doubling, and an activity, a core diameter is small to mutual and it aims at acquiring the optical coupling structure which can combine easily two optical fibers with which these core diameters moreover differ that there is no connection loss.
[0006] Moreover, invention of this claim 2 aims at acquiring optical coupling structure combinable without connection loss of an optical fiber using two optical connecters.
[0007] furthermore, invention of this claim 3 -- a lens -- using -- a light emitting device and an optical fiber -- connection loss -- it aims at acquiring optical coupling structure combinable few.
[0008]
[Means for Solving the Problem] The optical fiber of a pair with which core diameters differ, and the core diameter of each end face are equivalent to each core diameter of each above-mentioned optical fiber, and the optical coupling structure concerning invention of this claim 1 consists of optical fiber tapers by which welding was carried out by intervening between each above-mentioned optical fiber.
[0009] Moreover, the optical coupling concerning invention of this claim 2 consists of an optical connecter of a pair with which the paths of an optical coupling end face differ, and a long optical fiber taper to which the core diameter of each end face was connected by intervening between each above-mentioned optical connecter.

[0010] Furthermore, the optical coupling structure concerning invention of this claim 3 consists of a lens which condenses the light from a light emitting device, and an optical fiber taper with which while differ, and a core diameter receives and transmits the light which condensed with this lens to an end face.

[0011]

[Function] Since each core diameter of the optical fiber taper in invention of this claim 1 corresponds by that connection even if it connects with the optical fiber which is two from which a core diameter differs, it enables it to fully suppress connection loss of light conjointly with welding association.

[0012] Moreover, connection of the optical fiber taper in invention of this claim 2 is enabled without connection loss to the optical connecter which should be connected to the optical fiber with which paths differ, respectively.

[0013] Furthermore, association of the optical fiber taper in invention of this claim 3 is enabled without connection loss of the light from the light emitting device which condensed with the lens.

[0014]

[Example]

One example of invention of this claim 1 is explained about drawing below example 1. In drawing 1 , 1, as for the optical fiber of A, and 2, a core diameter has the optical fiber of B, as for 5, a core diameter has core 5a, the core diameter of the end is A, the optical fiber taper which is B, and 3 are each core medial axis, and the core diameter of 4 of the other end is the arc discharge in the case of fusion splicing.

[0015] Next, actuation is explained. First, in connection of each optical fibers 1 and 2 with which core diameters differ, the optical fiber taper 5 is intervened among these, and opposite arrangement of the equals is carried out for each end face of each optical fibers 1 and 2 and the optical fiber taper 5 about each core diameters A and B. Then, with this opposite arrangement condition, each above-mentioned end face is poked, and it joins, and considers as one connected optical fiber object by intervening between discharge electrodes and welding this joint in arc discharge.

[0016] Although that in which the core diameter of core 5a carries out a bend smoothly toward the other end from an end as a fiber taper 5 which is example 2., and which is used for the fusion splicing of optical fibers 1 and 2 in this example was shown What [a core diameter goes to the other end, and expands or reduces straightly from an end like drawing 2] drawing 3 -- like -- the other end from an end -- going -- a core diameter -- things -- a path may be changed in the shape of [S] a hard drum toward the other end from an end like the thing which Parts P and Q and the straight part R which connects these were made to follow, and drawing 4 , and the same effectiveness as the above-mentioned example is done so.

[0017] Example 3. drawing 5 shows one example of invention of this claim 2, and an optical connecter with the small path by which 5A was connected to the one where a long optical fiber taper and 6 have the comparatively smaller core diameter of this optical fiber taper 5A, and 7 are optical connecters with the large path connected to the one where a core diameter is larger in drawing. Although the optical fiber from which a core diameter generally differs can perform the optical transfer from the direction to the larger one where a core diameter is small by low connection loss, connection loss increases in the optical transfer from the direction to the larger one where a core diameter is conversely small.

[0018] So, in drawing 5 , since optical fiber taper 5A is lengthened as mentioned above and it is considering as the configuration which attached in these both ends the optical connecters 6 and 7 with which paths differ, when the optical fiber with which core diameters differ at these close outgoing radiation edges is connected, light bidirectional by low connection loss can be transmitted.

[0019] Example 4. drawing 6 shows one example of invention of this claim 3. This is the example which used the optical fiber taper for association of a light emitting device and an optical fiber. That is, as for the lens with which an optical fiber taper and 8 combine a light emitting device with optical fiber taper 5B, and, as for 9, 5B combines light, and 10, the luminescence light of a light emitting device and 3 are core medial axes. According to this, the luminescence light 10 of a light emitting device 8 is refracted with a lens 9, and incidence is carried out at the end face of optical fiber taper 5B, and an end face with the larger core diameter on a concrete target.

[0020] Generally, association with an optical fiber with a small core diameter and a light emitting device is very difficult, and since the joint loss is size, the optical fiber edge output after association becomes small. Like this invention, when a lens 9 and optical fiber taper 5B are used for association with a light emitting device 8 and an optical fiber, the joint effectiveness of a light emitting device 8 and an optical fiber increases, and there is effectiveness which can enlarge the optical fiber edge output after association.

[0021]

[Effect of the Invention] As mentioned above, while preparing the optical fiber of a pair with which core diameters differ according to invention of this claim 1 Since the optical fiber taper with which welding of the core diameter of each end face was carried out by corresponding to each core diameter of each above-mentioned optical fiber, and intervening between each above-mentioned optical fiber was formed A core diameter is small, and also in case welding of two optical fibers with which core diameters differ is performed, medial-axis doubling of a core becomes easy and it is effective in what can perform small fusion splicing of connection loss being obtained.

[0022] Moreover, since the long optical fiber taper to which the core diameter of each end face was connected by corresponding to the path of each above-mentioned optical coupling end face, and intervening between each above-mentioned optical connecter was formed while forming the optical connecter of a pair with which the paths of an optical coupling end face differ according to invention of this claim 2, it is effective in what can make very easily connection between optical fibers from which a path differs being obtained.

[0023] Furthermore, since the optical fiber taper with which while differ, and a core diameter receives and transmits the light which condensed with this lens to an end face was formed while preparing the lens which condenses the light from a light emitting device according to invention of this claim 3, it is effective in what can tell the light from a light emitting device to an optical fiber certainly without connection loss being obtained.

[Translation done.]

* NOTICES *

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view showing the optical coupling structure by one example of invention of this claim 1.
[Drawing 2] It is the sectional view showing other examples of the optical fiber taper in drawing 1 .
[Drawing 3] It is the sectional view showing the example of further others of the optical fiber taper in drawing 1 .
[Drawing 4] It is the sectional view showing the optical fiber taper in drawing 1 , and also other examples.
[Drawing 5] It is the front view showing the optical coupling structure by one example of invention of this claim 2.
[Drawing 6] It is the sectional view showing the optical coupling structure by one example of invention of this claim 3.
[Drawing 7] It is the sectional view showing the conventional optical coupling structure.
[Description of Notations]
1 Two Optical fiber
5, 5A, 5B Optical fiber taper
6 Seven Optical connecter
8 Light Emitting Device
9 Lens

[Translation done.]

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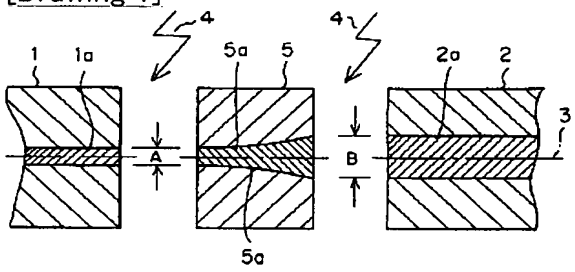
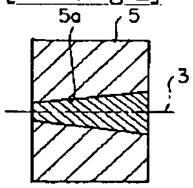
DRAWINGS

[Drawing 1]

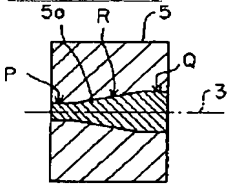


1, 2：光ファイバ
5：光ファイバテーパ

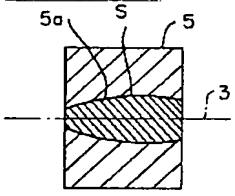
[Drawing 2]



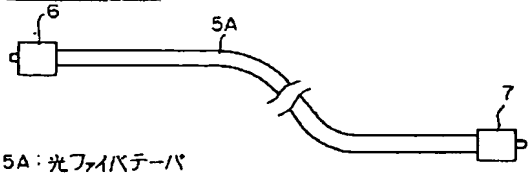
[Drawing 3]



[Drawing 4]

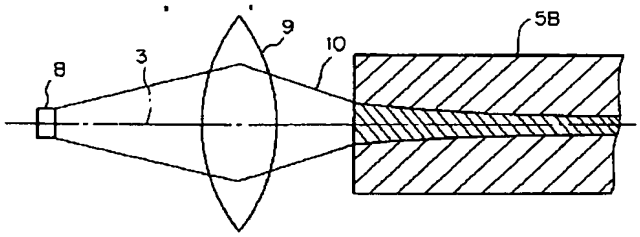


[Drawing 5]



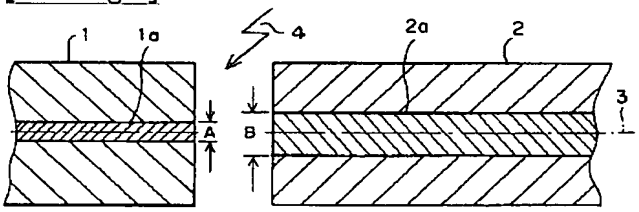
5A：光ファイバテーパ
6,7:光コネクタ

[Drawing 6]



5B：光ファイバテーパ
8：発光素子
9：レンズ

[Drawing 7]



[Translation done.]